What is claimed is:

1. A method of forming transparent mesostructured host materials that include optical or redox responsive moieties comprising preparing a self-assembling system by dissolving an inorganic network precursor, an optically responsive agent and a block copolymer in a solvent to form a mesostructured composite.

2. The method of claim 1 further comprising polymerizing or crystallizing said inorganic network precursors to form an inorganic network within the mesostructured composite.

3. The method of claim 1, further comprising covalently attaching the optically responsive agents directly to a functionalized component of the self assembling system or mesostructured composite, wherein said component is selected from the group consisting of a functionalized inorganic network precursor, a functionalized block copolymer and a functionalized inorganic network.

4. The method of claim 1, wherein the covalent attachment occurs either during or after self-assembly and inorganic network formation.

5. The method of claim 2 further comprising removing the block copolymer from the mesostructured composite to form a mesoporous solid.

6. The method of claim 5 wherein the block copolymer is removed by calcination or extraction.

7. The method of claim 1 wherein said inorganic network precursor is a metal alkoxide.

8. The method of claim 1 wherein said inorganic network precursor is selected from the group consisting of tetraethoxysilane (TEOS), tetramethoxysilane (TMOS), and tetrapropoxysilane (TPOS).

9. The method of claim 1 wherein said inorganic network is an inorganic oxide selected from the group consisting of Nb_2O_5, TiO_2, ZrO_2, WO_3, $AlSiO_{3,5}$, $AlSiO_{5.5}$, $SiTiO_4$, Al_2O_3, Ta_2O_5, SiO_2, SnO_2, HfO_2, $ZrTiO_4$, and Al_2TiO_5.

10. The method of claim 1 wherein the inorganic network is a metal oxynitride, metal oxychalcogenide, metal nitride, or metal chalcogenide.

11. The method of claim 1 wherein said block copolymer is an amphiphilic block copolymer.

12. The method of claim 1, said block copolymer comprising at least two different poly(alkylene oxide) blocks, wherein the alkylene oxide of one or more blocks has at least three carbon atoms.

13. The method of claim 1 wherein said block copolymer is a diblock, triblock, or star block copolymer.

14. The method of claim 1 wherein said block copolymer is is a poly(ethylene oxide)-poly(alkylene oxide)-poly (ethylene oxide) polymer where the alkylene oxide has at least three carbon atoms.

15. The method of claim 1, wherein said block copolymer is poly(ethyleneoxide)-poly(propyleneoxide)-poly(ethyleneoxide).

16. The method of claim 1 wherein said optically responsive agent is selected from the group consisting of lumiphores, chromophores, pH indicators, oxidation state indicators and chemically compatible combinations thereof.

17. The method of claim 1 wherein said optically responsive agent is present in the self assembling system at a concentration of about 0.10 wt% to about 10 wt%.

18. A method of forming an optically responsive mesostructured material, comprising:

i) preparing a self-assembling system by dissolving an inorganic network precursor species, a block copolymer, and an optically responsive agent in a solvent; and

ii) polymerizing or crystallizing said precursor species to form a mesostructured composite.

19. The method of claim 18 wherein said inorganic network precursor species is a metal alkoxide.

20. The method of claim 18 wherein said inorganic network precursor is selected from the group consisting of tetraethoxysilane (TEOS), tetramethoxysilane (TMOS), and tetrapropoxysilane (TPOS).

21. The method of claim 18 wherein said inorganic network is an inorganic oxide selected from the group consisting of Nb_2O_5, TiO_2, ZrO_2, WO_3, $AlSiO_{3,5}$, $AlSiO_{5.5}$, $SiTiO_4$, Al_2O_3, Ta_2O_5, SiO_2, SnO_2, HfO_2, $ZrTiO_4$, and Al_2TiO_5.

22. The method of claim 18 wherein the inorganic network is a metal oxynitride, metal oxychalcogenide, metal nitride, or metal chalcogenide.

23. The method of claim 18 wherein said block copolymer is an amphiphilic block copolymer.

24. The method of claim 18, said block copolymer comprising at least two different poly(alkylene oxide) blocks, wherein the alkylene oxide of one or more blocks has at least three carbon atoms.

25. The method of claim 18 wherein said block copolymer is a diblock, triblock, or star block copolymer.

26. The method of claim 18 wherein said block copolymer is is a poly(ethylene oxide)-poly(alkylene oxide)-poly (ethylene oxide) polymer where the alkylene oxide has at least three carbon atoms.

27. The method of claim 26, wherein said block copolymer is poly(ethyleneoxide)-poly(propyleneoxide)-poly(ethyleneoxide).

28. The method of claim 18 wherein said optically responsive moiety is selected from the group consisting of lumiphores, chromophores, pH indicators, oxidation state indicators and chemically compatible combinations thereof.

29. The method of claim 18 wherein said optically responsive agent is present in the self assembling system at a concentration of about 0.10 wt% to about 10 wt%.

30. A method of forming a transparent mesoscopically structured material that includes an optical or redox responsive moiety, comprising:

i) preparing a self-assembling system by dissolving an inorganic network precursor species and a block copolymer in a solvent;

ii) polymerizing or crystallizing said precursor species to form a mesostructured composite, said composite comprising an inorganic network;

iii) removing the block copolymer from the composite to form an inorganic network having mesopores; and

iv) loading an optically responsive agent into the mesopores of the inorganic network.

31. The method of claim 30 wherein said loading is conducted by adsorption or ion exchange.

32. The method of claim 30 wherein said inorganic network precursor is a metal alkoxide.

33. The method of claim 30 wherein said inorganic network precursor is selected from the group consisting of tetraethoxysilane (TEOS), tetramethoxysilane (TMOS), and tetrapropoxysilane (TPOS).

34. The method of claim 30 wherein said inorganic network is an inorganic oxide selected from the group consisting of Nb_2O_5, TiO_2, ZrO_2, WO_3, $AlSiO_{3,5}$, $AlSiO_{5.5}$, $SiTiO_4$, Al_2O_3, Ta_2O_5, SiO_2, SnO_2, HfO_2, $ZrTiO_4$, and Al_2TiO_5.

35. The method of claim 30 wherein the inorganic network is a metal oxynitride, metal oxychalcogenide, metal nitride, or metal chalcogenide.

36. The method of claim 30 wherein said block copolymer is an amphiphilic block copolymer.

37. The method of claim 30, said block copolymer comprising at least two different poly(alkylene oxide) blocks, wherein the alkylene oxide of one or more blocks has at least three carbon atoms.

38. The method of claim 30 wherein said block copolymer is a diblock, triblock, or star block copolymer.

39. The method of claim 30 wherein said block copolymer is is a poly(ethylene oxide)-poly(alkylene oxide)-poly (ethylene oxide) polymer where the alkylene oxide has at least three carbon atoms.

40. The method of claim 39, wherein said block copolymer is poly(ethyleneoxide)-poly(propyleneoxide)-poly(ethyleneoxide).

41. The method of claim 30 wherein said optically responsive agent is selected from the group consisting of lumiphores, chromophores, pH indicators, oxidation state indicators and chemically compatible combinations thereof.

42. The method of claim 30 wherein said optically responsive agent is present in the self assembling system at a concentration of about 0.10 wt% to about 10 wt%.

43. A method of forming a transparent mesoscopically structured material that includes an optical or redox responsive moiety, comprising:

i) combining a functionalized inorganic network precursor having a reactive group with a functionalized optically responsive agent having a complementary reactive group to form a derivatized optically responsive agent, said derivatized agent comprising an optically responsive agent covalently attached to an inorganic network precursor;

ii) preparing a self-assembling system by dissolving an inorganic network precursor, a block copolymer, and the derivatized agent in a solvent; and

iii) polymerizing or crystallizing said inorganic network precursor and the derivatized agent to form a mesostructured composite wherein the optically responsive agent is covalently anchored to an inorganic network.

44. The method of claim 43 wherein said inorganic network precursor is a metal alkoxide.

45. The method of claim 43 wherein said inorganic network precursor is selected from the group consisting of tetraethoxysilane (TEOS), tetramethoxysilane (TMOS), and tetrapropoxysilane (TPOS).

46. The method of claim 43 wherein said inorganic network is an inorganic oxide selected from the group consisting of Nb_2O_5, TiO_2, ZrO_2, WO_3, $AlSiO_{3,5}$, $AlSiO_{5.5}$, $SiTiO_4$, Al_2O_3, Ta_2O_5, SiO_2, SnO_2, HfO_2, $ZrTiO_4$, and Al_2TiO_5.

47. The method of claim 43 wherein the inorganic network is a metal oxynitride, metal oxychalcogenide, metal nitride, or metal chalcogenide.

48. The method of claim 43 wherein said block copolymer is an amphiphilic block copolymer.

49. The method of claim 43, said block copolymer comprising at least two different poly(alkylene oxide) blocks, wherein the alkylene oxide of one or more blocks has at least three carbon atoms.

50. The method of claim 43 wherein said block copolymer is a diblock, triblock, or star block copolymer.

51. The method of claim 43 wherein said block copolymer is is a poly(ethylene oxide)-poly(alkylene oxide)-poly (ethylene oxide) polymer where the alkylene oxide has at least three carbon atoms.

52. The method of claim 51, wherein said block copolymer is poly(ethyleneoxide)-poly(propyleneoxide)-poly(ethyleneoxide).

53. The method of claim 43 wherein said optically responsive agent is selected from the group consisting of lumiphores, chromophores, pH indicators, oxidation state indicators and chemically compatible combinations thereof.

54. The method of claim 43 wherein said optically responsive agent is present in the self assembling system at a concentration of about 0.10 wt% to about 10 wt%.

55. An optically responsive mesoscopically structured material comprising an inorganic framework, an amphiphilic block copolymer and an optically responsive agent.

56. The material of claim 55, said framework comprising an inorganic oxide.

57. The optically responsive mesoscopically structured material of claim 55 wherein the optically responsive agent is covalently attached to the block copolymer.

58. An optically responsive mesoporous material comprising a mesoporous inorganic framework having an optically responsive agent covalently attached to the framework.

59. The material of claim 58, said framework comprising an inorganic oxide.

60. An optically responsive mesoporous material comprising a mesoporous inorganic framework and an optically responsive agent adsorbed to the framework.

61. The material of claim 60, said framework comprising an inorganic oxide.

62. A solid state sensor device comprising a substrate layer and a sensing layer, said sensing layer comprising the optically responsive mesoporous material of claims 58 or 60.

63. The solid state sensor device of claim 62 wherein the device is a pH sensor.

64. The solid state sensor device of claim 63, wherein the device exhibits a response time of less than about two seconds.

65. The solid state sensor device of claim 63 wherein the optically responsive agent is fluoroscein.

66. The solid state sensor device of claim 62 wherein the device is a gas sensor.

67. The solid state sensor device of claim 65 wherein the device is an oxygen sensor.

68. The solid state senor device of claim 67 wherein the optically responsive agent is $Ru(bipy)_3^{3+}$.

69. A microring laser device comprising an optical fiber and one or more layers of mesostructured materials coating the fiber wherein at least one of said layers comprises the optically responsive mesostructured material of claim 55.

70. The microring laser device of claim 69 further comprising a mesoporous support layer coating the optical fiber and an optically responsive layer coating the support layer, the optically responsive layer comprising the optically responsive mesostructured material.

71. The microring laser of claim 69 wherein spontaneously emitted light is amplified as it propagates along the coated fiber.

72. A method of making a microring laser device comprising;

i) coating an optical fiber with a first layer comprising a mesoscopically structured inorganic/block copolymer composite;

ii) coating the first layer with a second layer comprising the optically responsive mesostructured compound of claim 55.

73. A method of forming an optically responsive mesoscopically structured material, comprising:

i) combining an amphiphilic block copolymer, an inorganic oxide precursor species and an optically responsive agent;

ii) applying pressure to said combination, whereby the block copolymer and inorganic oxide precursor are self-assembled into a mesoscopically structured composite; and

iii) polymerizing said inorganic oxide precursor species to form an inorganic oxide framework.

74. The method of claim 73 wherein pressure is applied to said combination by placing said combination on a substrate, placing a mold on said combination and applying said pressure to said mold.

75. The method of claim 73 wherein said mesocopically structured composite forms channels aligned parallel to the substrate plane.

76. A method of forming an optically responsive mesoscopically structured material, comprising:

i) contacting a mold, having a first open end and a second open end, with a substrate;

ii) combining an amphiphilic block copolymer, an inorganic oxide precursor species and an optically responsive agent and

iii) filling said mold with said combination by capillary flow from an open end whereby the block copolymer, inorganic oxide precursor species and optically responsive agent are self-assembled and polymerized into a mesoscopically structured composite.

77. The method of claim 76 wherein said mesocopically structured composite forms channels oriented in the direction of the capillary flow and aligned parallel to the substrate plane.

78. A waveguide device comprising a substrate, a mesoporous support layer deposited on the substrate, and a molded pattern on the support layer, said molded pattern comprising the optically responsive mesostructured material of claim 55, said material having a refractive index greater than that of the support layer.

79. The waveguide device of claim 78 wherein the molded pattern is shaped as parallel or curved stripes.

80. The waveguide device of claim 78 wherein the refractive index of the mesoporous support is about 1.15-1.3.

81. The waveguide device of claim 78 wherein spontaneously emitted light is amplified as it propagates along the waveguide.

82. A method of making a waveguide, comprising:

i) preparing a first self-assembling system by dissolving an inorganic oxide precursor and an amphiphilic block copolymer in an acidic solvent;

ii) applying a film of the first self assembling system on a substrate;

iii) polymerizing said precursor species of the first self assembling system to form a mesostructured composite;

iv) removing the amphiphilic block copolymer to form a mesoporous support layer;

v) preparing a second self-assembling system by dissolving an inorganic oxide precursor, an amphiphilic block copolymer, and an optically responsive agent in an acidic solvent;

vi) molding the second self-assembling system into a waveguide pattern on the mesoporous support layer by soft lithography; and

vii) polymerizing said precursor species of the second self-assembling system to form an optically responsive mesostructured composite.